LIVESTOCK FOR HUMAN WELL-BEING:

IDRC Research Opportunities Stemming from the Global Consultation on Livestock, Environment and Human Needs

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The Mission of the People, Land and Water (PLAW) PI is to help communities in Africa and the Middle East enhance the equitable, sustainable and productive utilization of land and water resources to improve their quality of life through support for research, research networks, and associated dissemination, utilization and capacity building.

Food insecurity and environmental degradation threaten the well-being of many peoples throughout the world. In some regions, livestock are the primary and supplemental sources of essential nutrients contained in meat, milk and eggs. They also provide other important products and services including manure, wool, leather and traction. Globally, the private sector and governments both continue to promote the development of the livestock sector. Many stakeholders view livestock production as culturally, economically, and environmentally appropriate form of land-use. Increasing demand for animal products and services drives the rapid intensification and expansion of the industry particularly in urban areas of developing countries. Countering this perception of the positive benefit of and need for livestock production is a growing concern among some people that the animals are a primary cause of environmental degradation. Challenges faced under intensive livestock production include ground water pollution, methane production, and disposal of animal wastes and by-products. In grazing and mixed farming systems, soil compaction, loss of vegetation, reduced biodiversity, lack of adequate grazing land, and animal-caused damage to crop lands are common. The growing anti-animal lobby increasingly attempts to discourage investment in international livestock research and development.

The interactions among livestock, environment and human well-being are complex and diverse affecting different countries in unique ways. Recognizing that confusion clouds rational prioritization of the international research and development agenda, the US Agency for International Development (USAID), the World Bank, and the UN Food and Agriculture Organization (FAO) initiated a major study intended to identify and clarify the important issues.

The International Development Research Centre (IDRC) through its *People, Land and Water Program Initiative for Africa and the Middle East* (PLAW) and its *Alternative Approaches to Natural Resource Management in Latin America and the Caribbean Program Initiative* (MINGA) joined this international effort by organizing a global consultation using a moderated global conference that involved more than 800 participants in 84 countries and face-to-face meetings for some selected stakeholders who do not have access to E-mail. This publication highlights the major research issues arising from this consultation emphasizing those that relate to IDRC's programming priorities. PLAW and MINGA hope that this document will serve as a useful guide to the appropriate inclusion of livestock in the Centre's research agenda during the coming years.

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Abstract

From an analysis of the global consultation, Balancing Livestock, Environment and Human Needs, and of a multi-donor study conducted by the World Bank, the FAO and the USAID, issues and research opportunities in accordance with IDRC`s priorities are outlined. This paper begins with a short discussion of IDRC`s priorities, and of the Program Initiatives in whose work livestock issues are important. It analyzes the issues of relevance to IDRC that were discussed in the global consultation, and those that were not given enough attention. The research needs identified by the multi-donor study and the global consultation are presented. Finally, eleven areas in which IDRC, given its priorities and expertise can make a significant difference in balancing livestock, environment and human needs are identified. These include: addressing the role of women in livestock, environment, and human interactions; understanding and enhancing the bio-physical and socio-economic roles of livestock in environmental recovery; increasing the productivity of mixed systems without sacrificing their social and environmental benefits as an alternative to specialization of livestock systems; understanding human adaptation to dynamic arid ecosystems; developing effective resource conflict prevention and resolution mechanisms; understanding traditional breeding practices in relation to their cultural and socio-economic contexts; monitoring livestock related environmental degradation; refining methods of urban livestock keeping; addressing issues of intensification of livestock production in developing countries; and improving the effectiveness of electronic multi-stakeholder consultations. The paper concludes in the assertion that the causal link between livestock and environmental degradation is indirect and that more understanding is needed of the human intervening variables, and the effects on human beings.

I. INTRODUCTION

Livestock play essential roles in the lives of millions of people around the world today. In spite of this, the past decades have seen a general decline in international development aid dedicated to the livestock sector. There has also been an increasingly evident livestock policy void at various levels which is resulting in the lack of informed and integrated approaches to the sector. One of the factors contributing to this neglect of livestock issues is that public opinion in industrialized nations has generally turned against government spending on livestock development. This is at least partially based on a common misperception that it is the livestock themselves and not the way in which they are kept, fed and bred that are responsible for environmental degradation. Meanwhile environmental degradation, human suffering - poverty, illness/disease, malnutrition, and violent conflicts, often with close relation to the interplay of livestock systems with humans and the environment, continue.

In this context, the FAO, USAID and the World Bank, with funding from a number of donors[1], undertook a major study titled *Balancing Livestock, Environment and Human Needs*[2]. From the standpoint of the International Development Research Centre (IDRC), in whose programming priorities are deeply embedded considerations of social and gender equity, poverty eradication participatory decision-making, traditional knowledge, sustainable environmental management, and local food security, it was important that this study --written by livestock specialists in the developed world, and posed to be a significant source of livestock sector development policy directions and actions in the coming years-- be put to the scrutiny of a variety of stakeholders, particularly those from developing countries. It was proposed that there be a global consultative process involving an electronic conference and a series of face-to-face interviews and roundtables with people, in key areas of the world who do not have access to electronic communications (Internet, E-mail). The consultation was jointly organized By the International Livestock Research Institute (ILRI), IDRC, INFORUM, and FAO. Important inputs were provided by the World Bank and the Interamerican Institute for Cooperation in Agriculture. Several other institutions collaborated in the conduction of the local, non-electronic consultations.

The purposes of this paper are twofold: The first is to reflect on the material produced[3] by the consultative process that are of relevance to IDRC; and to highlight areas of convergence and difference, and important omissions. The second objective is to identify areas in the livestock, environment, human needs dialogue where IDRC, given its mandate, expertise and priorities can make a difference. This paper will not discuss whether or not the consultative process was successful, and what the lessons from the process are. Instead, reference will be made to a parallel paper dedicated solely to the process of the consultation and the evaluation thereof.

This paper is divided into four main sections. The first provides a conceptual framework for the paper based on IDRC`s priorities. This will be the basis of selection of the issues that are presented and the research opportunities identified in the following sections. The second section is a survey of a number of issues within the livestock, environment, human needs problematique, that are important to IDRC and that were discussed in the multi-donor study and the global consultation. Important issues that were not discussed will be highlighted. A third section will present the numerous research needs identified during the process of the consultation and in the multi-donor study. The fourth section will draw from these and the discussion in the previous two sections to identify opportunities for IDRC in livestock, environment, human needs

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[1] The study was funded by the Commission of the European Communities, the World Bank, and the governments of Denmark, France, Germany, The Netherlands, United Kingdom and the United States of America.

[2] Hereafter referred to as the multi-donor study. Full reference is available in the reference section at the end of the paper.

[3] This includes the multi donor study, the electronic exchange, the case studies, the roundtable reports and the evaluation questionnaires.

research.

II. IDRC`S PRIORITIES

The multiple facets of livestock-environment-human needs interactions can, very appropriately, be placed within the framework of IDRC`s mandate, and the themes and priorities that structure our current Corporate Program Strategy (1997-2000). In this paper, emphasis will be placed on several of IDRC`s Program Initiatives (PIs) in which livestock-human-environment interactions are not only relevant, but key, namely: People Land and Water (PLAW), Alternative Approaches to Natural Resource Management in Latin America and the Caribbean (MINGA) and Community Based Natural Resource Management (CBNRM). Although these three Program Initiatives (PIs) have different regional foci - Middle East and Africa; Latin America and the Caribbean; and Asia respectively- they all deal primarily with sustainable agriculture and resource management[4].

Central to each of these PIs is environmental degradation and poverty as it affects the lives and food security of people who are most marginalized from the mainstream of economic development and human well-being. Many of these people are rural poor who have insecure tenureship (if any) of the resources on which they depend. These resources are often either marginal and/or rapidly degrading due to a number of factors including population pressure and/or poor management. There is a thrust in the three PIs toward the productive and sustainable use of these resources. Livestock can have important effects both positive and negative on this effort.

Closely related to this set of concerns, is the interplay of livestock, environment and human health. Livestock play important roles in the integrity of ecosystems in which they live. The ways in which they are managed have implications on human health both directly (nutrition) and indirectly through the environment (disease, water contamination). The Ecosystem Health PI is mainly concerned with the ways in which the range of social, economic, political and environmental conditions in which people live, affect their health and well-being and vice versa. This undoubtedly has its place in the analysis of livestock, environment, and human interactions.

Another set of issues that is central to IDRC`s priorities is the participation of farmers/pastoralists and local people in research and development. The interest in local knowledge, strategies and capacity for sustainable resource management is common among the CBNRM, PLAW and MINGA PIs. This touches on a number if issues. Local knowledge, particularly with regard to biodiversity conservation and the use and preservation of local resources is important mostly to CBNRM and PLAW and it is the main area of focus for the

[4] Some attention will also be paid to areas of convergence with other Program Initiatives` work (for example Cities Feeding people, Sustainable Uses of Biodiversity and Ecosystem Health). However, the primary focus will remain on the above mentioned Program Initiatives.

Sustainable Uses of Biodiversity (SUB) PI. Local organization, power relations and institutional capacity, and the relation between these and outside forces (national, regional and international policies) are subjects that MINGA and CBNRM are mostly active in. Social and gender equity in natural resource use and management decision-making is an underlying theme in these considerations. Finally, and albeit to varying degrees, the three PIs (MINGA, PLAW and CBNRM) emphasize the need for multi stakeholder approaches to resource conflict prevention and resolution.

The global consultation on Livestock, Environment and Human Needs is also extremely relevant to IDRC because of its innovative use of information and communication technologies (ICTs). This is of interest to the PAN Asia Networking and ACACIA Program Initiatives, and to the Bellanet Secretariate that work on issues of information and communication. The process of the electronic conference, the idea of integrating electronic and non-electronic media, and the achievements of the consultation in bringing out the views of stakeholders from the developing world are all very important to IDRC. These, and a set of guidelines on how to replicate this process while improving on it, are presented in another paper titled *Guidelines for Organizing an Electronic Conference: Lessons from the Global Electronic Consultation on Balancing Livestock, Environment and Human Needs.*

III. LIVESTOCK ISSUES OF IMPORTANCE TO IDRC

The electronic conference, and the face-to-face meetings (together referred to hereafter as the global consultation) discussed a wide variety of issues and themes ranging from nutrient cycling to the types of subsidies and financial incentives that cause livestock production to have damaging effects on the environment and on human well-being. Many of these issues are areas of priority for Canada in its approach to international development and fall under IDRC`s six programming themes and twelve Program Initiatives. Conversely, there are issues that are important in livestock-environment-human interactions, and to IDRC, that were not brought up in the global consultation at all. The following two sub-sections will address these sets of issues.

III. A. Issues Discussed of Importance to IDRC

The issues of direct relevance to Canadian/IDRC priorities that were discussed in the consultation are as follows:

Role of Livestock in Environmental Management and Restoration

Oftentimes livestock are blamed for the deforestation, soil degradation, water contamination etc. that they are, in one way or another associated with. It was quickly agreed at the outset of the

electronic exchange[5], that it is the way in which livestock and natural resources are managed that are to blame for environmental degradation, and not the livestock themselves. It was also agreed that much of the degradation attributed to livestock can be restored by livestock - if properly managed.

This idea sparked some exchange in the electronic conference about methods of using animals in mixed and grazing systems. Holistic Range Management (HRM), Management Intensive Grazing (MIG), and the specific attributes of different range grasses were mentioned. For the most part, the discussion on the role of livestock in environmental management centered on ways of preventing degradation (nutrient cycling and terracing for example) or for conservation. There was very little discussion on ways in which livestock can bring something to a system that has been lost due to previous practices (restoration).

Given the recent advances in understanding about the need to replenish soil fertility in many areas such as mixed farming systems in sub-Saharan Africa, considerable opportunities exist to further our understanding of roles that animals can play in this task. It is now known that in order to re-capitalize soil productivity, farmers require a short term return on their investment and effort. Dairy production is one of the key ways in which farmers can be encouraged to invest in restoration of their soils. A comment to this effect was made in the electronic exchange whereby a participant mentioned that in certain extensive grazing systems, intensification (MIG) could serve the dual purpose of freeing-up land for restoration while increasing revenue that could be invested in recovery. This was not discussed any further, nor was it brought up in the multi donor study or the roundtable reports. From IDRC`s perspective, the benefits that could accrue to communities through this type of activity are many, but are likely to be conditioned by a number of social, economic and political factors including land and animal tenure and markets. This is an area in which more research is very promising.

In the Southern Cone of Latin America mixed farming systems (crops and livestock) provide the means for recuperation of degraded soils through the use of pastures and the reversal of the environmental deterioration processes caused by agriculture.

Role of Livestock in Agricultural Intensification

In many eco-zones, sustainable agricultural intensification is dependant on the integration of animals, crops and people. If animals (or their services) are not present in these agricultural systems, intensification is most likely to occur with the use of inorganic fertilizers and mechanized traction, both of which have associated environmental costs.

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[5] No explicit effort was made during the conference to seek consensus among the participants on the many issues that were discussed and the varying views that were introduced. For the purposes of this paper it is assumed that where there was discussion with no disagreement on the part of other participants, there was agreement.

There was some debate on this hypothesis in the mixed systems breakout group. A number of participants disagreed with the multi-donor study on the emphasis put on the contribution of animals to maintaining nutrient balance citing studies that showed that only a percentage of the nutrients taken by animals are restored by the use of manure. Supplementation of animal feeds with minerals (i.e. phosphorus) could have the dual effect of improving animal productivity as well as
contributing to soil fertility. No conclusion was arrived at in the electronic conference although the roundtable reports that talked about mixed systems seemed to coalesce on the view that the contribution of animals in agricultural systems is significant. This debate is extremely important to IDRC in terms of food security and natural resource management, especially for smallholders cultivating marginal lands and in areas that are densely populated and undergoing environmental stress as a result.

Evolution of Livestock Systems

The authors of the multi-donor study establish that given the past trends and recent projections for the relative productivity of the three livestock systems (grazing, mixed and industrial), and in spite of the anticipated increases in feed prices, industrial systems will continue to grow rapidly, and have much higher prospects of meeting the growing global demand for animal products than do grazing or mixed systems (de Haan et al., 1997a: 13). While making this statement, the multi-donor study also asserts that mixed systems, as closed systems, are the most potentially benign for the environment. Observing the overall trend of intensification and specialization of livestock systems, the authors postulate that one of the main challenges for the livestock sector is to determine ways to allow mixed systems to grow while "sustaining their environmental equilibrium".

Several participants of the electronic conference disputed these interpretations on the relative potential productivity of the different systems and their environmental soundness. One group of participants held that grazing systems still have considerable potential for growth. They cited examples from Argentina, Uruguay, Mexico and Southern Brazil. Grazing systems were also favoured by participants of the electronic exchange as an option for reducing dependance on feed crops which are chemical and energy intensive, and for biodiversity preservation. While there was disagreement among the participants on the contribution of livestock to maintaining nutrient balance in mixed systems, many questioned the assumption that mixed systems are unable to satisfy rising demand for animal products effectively. One participant, followed by a few others, made a statement against the acceptance with which the multi donor study and the electronic exchange were treating the global market forces that are, to a great extent, driving these trends. They argued that these forces are social constructs, and as such can be reversed or modified to meet the objective of finding a balance between environment and human needs.

From IDRC`s perspective, while the trend of intensification and specialization of livestock systems may have occurred, and may be occurring in different parts of the world, appropriate quantitative documentation of this process is lacking. Specialization of livestock systems in

developing countries may be a way of coping with population demands, however the economic, environmental and social impacts of such intensification in the different eco-regions of the world need to be known. For example, the possible implications of the displacement of smallholders and their systems of natural resource management have to be considered carefully. The institutional and legislative structures needed to avoid pollution problems associated with intensification in developed countries (i.e. the Netherlands) need to be functional in developing countries. There is a clear need for research on this subject, as the type of livestock production systems that will need to be promoted in the future will depend on the appropriate balance of livestock, the environment and human needs.

Influence of Outside Forces on Livestock Systems

In all the components of the consultation -the electronic exchange, the case studies, and the roundtable reports- and in the multi-donor study, reference was made to external factors that affect livestock systems. These factors include expanding [urban] markets, national/international policies and laws (including subsidies, land legislation, and economic, social and environmental policies), global economic forces, other claims on and potential uses of natural resources etc.

The frequency with which these external factors were mentioned emphasizes that the balance between livestock, environment and human needs is not only a matter of the decisions that are made at the livestock production level but one of broader policy issues such as national strategies for food security, the provision of cheap food to urban populations for social and political reasons. The discussions did not delve much further into this issue except to stress the need to reduce or eliminate subsidies on feed production and trade and to call for the implementation of appropriate environmental regulations and impact assessment procedures for livestock production. The majority of the participants pointed out that policy makers (and other stakeholders) had to be well informed and sensitized to livestock-environment-human needs issues (by scientists), and most preferably, brought into this discussion.

Demand Management

Livestock product demand management was one of the first issues to be brought up in the initial plenary session during which the keynote paper was discussed. This refers to the control, or the influencing of consumer demand of animal products presumably by means of public awareness campaigns, or, alternatively by pricing policies. In their paper, the authors argued that although consumption levels are too high in most industrialized countries, this is far from the reality in many developing countries. Moreover, as populations and incomes rise, and urbanization continues in these countries, demand is bound to continue growing. Some of the conference participants disagreed with this view and argued that one of the ways of mitigating the negative livestock, environment, human interactions is to “control” demand. This debate is important because it has health implications both in the industrialized world (for example the high incidence of heart disease) and in the developing world (in many areas livestock are the only source of vitamin A and essential minerals such as iron and zinc which affect cognitive

capacity). It is also important because it touches on the broader social, economic and political policies of governments and the ways in which these affect livestock systems, and in turn their interaction with the environment.

Although the links were not explicit in the conference, the issues of demand, or growth in demand for animal products, and the availability of cheap food stuffs (including animal products - milk and meat in particular) to urban dwellers - an issue brought up many times in the electronic exchange- are closely related. There was a general lack of discussion of the social, economic and political aspects of urban food consumption as it touches on livestock production although many participants and the authors themselves noted urbanization as a key external factor affecting livestock systems.

This is important to IDRC as populations in the developing world are growing most rapidly in urban areas and so, congruently are the number and percentage of urban poor. Whereas research shows that small-scale urban agriculture is increasingly important as a source of food for city dwellers, especially for low income sectors (Mougeot, 1994), the multi-donor study and the global consultation failed to make mention of it. This, and the potential health and environmental implications of urban livestock production are an important area and opportunity for further research.

Resource Tenure and/or Access

The nature of resource tenure and access regimes has a direct bearing on how resources are used. This is true for land, water, and for animals. Changes in land ownership and access, and animal tenure have implications on natural resource management practices and thus on livestock, environment and human interactions. Many of the participants drew attention to this fact as did the multi-donor study.

Some of the participants disagreed with statements made in the multi-donor study. One disagreed with the author`s statement that soil erosion could be controlled by securing land tenure and argued that there is little evidence to this effect. A number of others raised their concern that the multi-donor study recommended communal or public land tenure for pastoral systems while recommending secure land tenure for mixed systems. These two recommendations, they argued are irreconcilable as often, the two systems coexist or interrelate. Another group of participants noted that the multi donor study overlooked the change in livestock ownership from pastoralists to new and old elites. They argued that this change will change land and vegetation utilization in arid and semi arid areas. Yet another participant drew attention to the relationship between livestock ownership and land ownership suggesting that farmers that use animal traction are able and thus seek to cultivate larger plots than those who do not. No conclusion was drawn from these discussions, nor consensus reached on the relation between resource tenure and sustainability of livestock systems although this is clearly an issue of great importance to livestock, environment, human needs interactions.

Arid Ecosystem Dynamics - "Non-Equilibrium" Theory

Discussion of the limits of the existing knowledge and understanding of vegetation dynamics in arid areas was very lively in the electronic conference. Some, including the authors, argued that these ecosystems are in constant disequilibrium and thus regulating stocking rates would be futile, if not detrimental both socially and environmentally. Others agreed but drew attention to the dangers of accepting or adopting non-equilibrium theory as an assumption in management practices. Consensus seemed to be reached on the need to identify and monitor for thresholds beyond which an ecosystem cannot revert to previous conditions.

Most of the comments in the electronic exchange on "non-equilibrium" in arid and semi-arid grazing systems centred on the bio-physical dimensions of it. There was little, if any, discussion of the impact of "non-equilibrium" on human beings and the coping mechanisms that people have used, or are using to adapt to it. This is relevant because people have been living and keeping animals in these ecosystems for centuries. Although it is still debated whether their practices were/are sustainable or not, it is important to know how they were/are coping, and if their coping mechanisms (and the effect of these have on the environment) are being affected in negative ways by changes in the outside forces (land encroachment by new settlers, national/ international policies) that they confront.

Conflict Between Contending Natural Resource Users

As resources degrade and/or otherwise become more scarce, conflicts arise among contending users. This was reiterated numerous times in the case studies, roundtable reports and in the electronic exchange. For example one of the grazing systems case studies mentioned cultural and linguistic conflicts between local Sindhi speaking people and outsider Punjabi speaking people in the Sindh Region of Pakistan, as an impact of environmental degradation on people (Umrani, 1997). The multi-donor study recognized the relationship between environmental degradation and human conflicts, citing examples of armed conflicts in East Africa, and suitably recommended the development and refinement of conflict resolution and prevention schemes albeit only for the arid grazing systems.

In spite of these examples, there was very little discussion in the consultation and in the multi-donor study on *how* resource scarcity can lead to conflict, and how such conflict can be resolved or avoided. As it is foreseeable that violent conflicts stemming from environmental scarcity will increase in the coming decades (not only in East Africa), and given the devastating effects of conflicts on both humans and the environment, this is a crucial area for further research.

Networking Among Stakeholders

The need for greater communication and information exchange between scientists, environmentalists, policy-makers, entrepreneurs and researchers was a major point of consensus in the consultation. It was argued that greater communication could help in the sharing of

knowledge about the current states of livestock systems as they relate to the environment and to human needs. It could also be instrumental in making policies responsive to the real needs of the sector, and in preventing public misconceptions about the interactions of livestock, the environment and human beings. In addition, many participants said that increased dialogue between stakeholders and disciplines would help bring a more holistic approach to decision making and to research, and would facilitate multi disciplinary analysis. This point was made in every stage of the conference reflecting its importance to both the participants and the organizers. The global consultation on livestock, environment and human needs is an important step in the learning process of how multi stakeholder consultations can be facilitated and enhanced by the use of ICTs (Hart, 1997). This is an area in which IDRC is already engaged.

Participation in Resource Management Decision Making

Farmer/pastoralist and community participation in resource management was mentioned often in the consultation and in the multi-donor study. There are at least two aspects of this that were addressed. One was the need to engage local people to ensure that projects are relevant to local cultures and situations, and that initiatives do not overlook local institutions. The other was the importance of local knowledge of the environment and of the animal breeds in question. There was agreement that the participation of local people in resource management and decision making was essential, however methods of participation were not discussed. Many pointed out in their evaluations that the consultation would have benefitted greatly from the participation of farmers/pastoralists. Methods of encouraging local participation in research and development, an area that is central in IDRC`s approach, was not mentioned.

Free Market and Sustainable Livestock Production

The internalization of environmental costs in the prices of livestock products was an issue of hot debate in the electronic conference. The multi-donor study suggested that a free market would lead to more balanced livestock, environment, human needs interactions and would allow the livestock sector to react more quickly and effectively to changes in demand for livestock products. This discussion focused mostly on the negative effects of subsidies on fuel, agrochemicals, and feed production in general.

Several of the participants disputed the authors` hypothesis on grounds that unless environmental costs are included in production costs, economic instruments and environmental regulations could not be expected to have any positive effect on livestock, environment, and human interactions. They suggested that in such discussions a distinction be made between price policies and subsidies, and standards, rules and regulations (McCalla and de Haan, 1997). It was argued that fostering positive livestock- environment interactions would require more government involvement in the latter not necessarily the former.

Another aspect of this debate on the market mechanisms for environmental protection was the willingness/reluctance of consumers to pay more for environmentally benign products. One of

the most contentious issues brought up within this discussion was the ethical and practical questions of charging "more" to the urban poor for animal products that reflect environmental costs. No conclusion was drawn. In some cases there is great concern on the development of sanctions based on environmental restrictions imposed by markets in developed countries which basically become non-tariff barriers (Chifflet and Arellano Soto, 1997).

Investment Opportunities for Farmers/Pastoralists

Comments made in the various components of the consultation showed that contrary to the assertion in the multi-donor study that the non-food functions of livestock are in decline, many people around the world continue to keep livestock for reasons other than the production of animal products. Although animal traction and social/spiritual and recreational purposes were mentioned from time to time, the most common non-production function of livestock mentioned in the consultation was that of saving and investing the household`s income. Many participants attributed high livestock densities to the insecure access to markets, the unstable prices for their other products, risk avoidance and the lack of alternative investment opportunities (or the lack of trust in those available).

Technology Adoption

It was widely agreed in the electronic conference that much of the technology and technical solutions already exist, and that the main problem is that of lack of adoption by local people. For the most part, this is due to cultural, socio-economic and political factors. No solution was arrived at.

Human Health

Issues of human health in relation to livestock production and consumption were brought up in the consultation but were not discussed at any length. The areas mentioned by the participants are the risks associated with antibiotics as feed additives (Umrani, 1997); the poor nutritional value of industrial poultry due to high nitrate and fat contents; the nutritional importance of minerals such as zinc and iron (found in animal products); the incidence of taeniasis (tape worm) and cysticercosis; and health problems associated with household animal keeping. Two case studies on swine production in Mexico (Perez, 1997) and in the Cibao Region of the Dominican Republic (Sanchez, 1997) mention gastric diseases and other human health problems related to water pollution from industrial production. The multi-donor study only mentions human health in a short discussion of demand management, excess consumption in the industrialized world and associated high blood pressure and cardiovascular disease.

Water and air pollution from discharges of industrial systems are an evident source of potential health ailments, especially in many parts of the developing world where environmental regulations are not enforced or do not exist, and where the adoption of technologies for the

mitigation of such pollution is lagging. In urban areas, the increasing densities of both human and animal populations will likely enhance the chance of serious health problems arising.

Poverty

Poverty is recognized to have a very direct link to environmental degradation and was often cited in the consultation as one of the driving forces causing livestock production to have detrimental environmental effects. Very little however was suggested as means of eradicating it, or of averting or halting the process of impoverishment. Among the few that addressed the issue head on, one of the case studies drew attention to the link between inequality in social structures and the existence of chronic poverty that leads to unsustainable land use. It was suggested in this case study that our unit of analysis should not be the "livestock system", but instead the broader and deeper context in which environment-social conflicts arise. The understanding and solutions required go well beyond the livestock system.

III. BIssues of Importance to IDRC that were not Discussed

Some issues that rank high in IDRC`s priorities and are of evident importance to sustainable livestock production were generally neglected in the consultation. They include:

Gender

Discussion on gender was almost completely absent from all the facets of the consultation. There is ample evidence however that women play important and often different, but complementary roles to men, in livestock production systems (mostly in mixed, grazing and household systems). In small-scale mixed farming systems in the Mantaro Valley of Peru for example, women possess much of the local knowledge of animal health, nutrition, and selection, and make crucial management decisions with regard to grazing strategies and breeding practices (Fernández-Baca, 1994). Among the Afghan Pashtun nomads, the Koochi, women play significant roles in the care of livestock (especially when they are newly born, or when they are ill), and their knowledge of animal health and disease is equal if not superior to that of Koochi men (Davis, 1995). In parts of Africa, women are often responsible for collecting fodder and water for animal production in small-scale mixed systems.

It is known that due to the structures of societies and their institutions, women are almost always affected by policies, developments, and changes in different ways than men are. Hence, the environmental, economic, land-use, social and cultural changes that will accompany the trend towards urbanized and intensified livestock production will have a profound but varying impact on women and on men. These differences are not yet completely understood but are extremely important. Gender analysis has to be carried out, if R&D is to be effective,.

Progress in Monitoring and Evaluating Trends in Livestock-Based Ecosystems

The need for methods of conducting sociological and economic analyses of the environmental degradation thought to have been caused by livestock production was highlighted in the global consultation. This need has been recognized for many years, but there has been little effective progress in implementing, monitoring and evaluating trends in livestock-based ecosystems. This was not discussed in any depth in the consultation.

Inequity in the Distribution of Environmental Costs, and the Benefits of Livestock Production

Many of the environmental challenges associated with livestock production reflect the fact that the negative consequences often result from externalities. Often, the costs of harmful effects of livestock production are born by people who have no control over the animals and who derive no direct benefit from them. This is the case of the millions of urban poor who often cannot afford to consume livestock products from industrial systems (never mind produce animals in this way), but who endure the contamination of water supplies, and air pollution emanating from farms or processing facilities (slaughter houses, tanneries); or, of peasants who are displaced, or otherwise deprived of productive land (and therefore cultivate marginal land) due to extensive ranching operations on scarce land.

Conversely, in some cases, livestock producers bear the costs of environmentally destructive natural resource management practices and policies that are beyond the realm of their influence. Perhaps the biggest research challenge lies in identifying ways by which externalities can be internalized within the livestock production systems.

Water

Water is essential to livestock production in all systems and all eco-zones. As living beings animals need to drink water and no matter what they are fed, it needs water to grow and/or to produce outputs (ie. Milk). In addition to depending on water, livestock also affect water supplies in significant ways. As was mentioned above, water pollution from industrial livestock production is a big health concern in developing countries where regulatory frameworks for the protection of natural resources do not exist, or are not enforced. Grazing and mixed systems also impact on water quality as humans often drink the same water around which animals gather, drink, defecate and urinate. Water was mentioned in passing in the consultation but was not given the importance and attention it deserves.

Population v/s Inequity as Cause of Environmental Degradation

Both the multi-donor study and the consultation mention population pressure repeatedly as a major factor causing livestock to have negative impacts on the environment. This would lead one to believe that we have reached, or are rapidly approaching the Malthusian limits of population

growth. While this is true in some places, it is not true everywhere. Without making this distinction between structural and demand induced environmental scarcities, policy prescriptions can be grossly inaccurate leading to further imbalances between livestock, environment and human needs.

The population argument must be complemented with considerations of structural inequities in access, ownership and usage of resources. It is often because of these inequities that many people find themselves cultivating crops and/or raising livestock on land that is highly susceptible to degradation and for the most part inappropriate for these activities. The population argument must also be balanced with consideration of the fact that different populations, and different sectors of populations place higher/lower demands on natural resources (by virtue of their activities, values, and consumption patterns) than others do.

IV. RESEARCH NEEDS IDENTIFIED

Analyses of the multi-donor study, the electronic conference, and the face-to-face meetings revealed a large number of research topics that various stakeholders believe must be addressed in the future. These are listed in Table 1. While traditional range and animal improvement issues arose, participants in the global consultation also emphasized the need to consider innovative approaches to monitoring and evaluation of the state of the livestock ecosystems, to preserve bio-diversity of the livestock genetic wealth, to address numerous policy issues, and to encourage training and capacity building in various fields of study. A key subject area identified was an increased need for ecosystem level research rather than a more traditional sectoral approach. Information exchange was also a prominent priority characterizing the difficulty many colleagues in developing countries face in carrying out the activities. Table 2 presents some of the needs identified with regard to monitoring and evaluation and the need for information systems.

Table 1. Research Issues Identified in the Multi Donor Study and the Global Consultation on Livestock, Environment and Human Interactions

HYPOTHESES AND RESEARCH ISSUES	LIVESTOCK SYSTEM
Ecosystem Research	
- improved agrosilvopastoral systems	G, M
- applied research on improved nutrient cycling	G, M
- soil erosion control using alternative crops, mulch, terraces, contour planting, etc.	M
- test implication of "non-equilibrium" theory in arid grazing systems	G

HYPOTHESES AND RESEARCH ISSUES	LIVESTOCK SYSTEM
- shared utilization of resources by diverse users	G, M
- nutrient management in intensive grazing systems	G
- model that explains environmental degradation	G, M
- methods of integrating multi-sectoral information and knowledge	G, M, I
- systemic factors leading to mis-allocation of natural resources	G, M, I
- integrated control of pests and diseases	G, M
- sustainable options for land-use	G, M
Range-Pasture Management	
- artificial re-vegetation techniques of degraded range	G
- pasture improvement techniques adapted to local soils and environments	G
- increase quantity and quality range to reduce need for irrigated forage crops	G
- better quality forage to allow crop residues to be returned to the soil	M
- water harvesting	G
Animal Improvement and Production	
- efficient use of improved feeds, adaptation to local conditions	M
- optimize use of concentrate and non-concentrate feeds in developing countries	M, I
- feed supplement strategies for dairy cows using nutritional indicators	M
- animal health and disease preventions	G, M
- improved breeds, mixed species production	G, M, I
- optimal supplementation of lactating and growing animals	M
- more efficient fattening systems to encourage maintenance of fewer animals	M
- improved feed efficiency	M
- alternative energy technologies to replace fuel wood dependence (bio-gas and solar)	M
- defining proper stocking rates	G, M
- defining affordable and adoptable animal traction technologies	M
Bio-Diversity	
- shift selection from individual traits to lifetime and herd productivity	G, M
- determine (DNA analyses) the number of breeds that should be conserved	G, M
- develop selection goals based on environmental capacity for animal production	G, M
- genetic component of adaptation (e.g., tick resistance, use of body stores)	G, M
- develop methods to determine economic value of animal genetic resources	G, M
- conservation of indigenous genetic resources	G, M

HYPOTHESES AND RESEARCH ISSUES	LIVESTOCK SYSTEM
Policy and Institutions	
- alternative savings systems to reduce the need to keep large herds	G, M
- hypothesis: secure land tenure helps promote better land management	G, M
- shift from pastoral to elite animal ownership in West Africa causes land degradation	G
- describe socio-economic constraints to the adoption of technologies by farmers	G, M
- compatibility of environmental standards across countries	G, M, I
- role of institutional frameworks in encouraging access to and improvement of land	G, M
- understanding pastoral institutions	G
- appropriate conflict resolution schemes	G, M, I
- identify institutional structures and incentives to intensify production & reduce grazing pressure	G, M
- improved land-use policies	G, M
- design decentralized Natural Resource Management to cope with drought	G
- design financial banking and insurance strategies to mitigate impact of drought	G
Capacity Building	
- capacity building in rangeland management, affluent disposal	G, I
- soil conservation	G, M
- methods of integrating multi -sectoral information and knowledge	G, M

"G", "M" and "I" refer to grazing, mixed and industrial systems respectively

Table 2. Expressed Needs for Monitoring, Evaluation, and Information Exchange

HYPOTHESES AND RESEARCH ISSUES	LIVESTOCK SYSTEM
Monitoring and Evaluation	
- indicators to assess weather, animal and human induced changes to grazing lands	G
- methods for economic evaluation of investments to convert pastoral land to crop land	G, M
- socio-economic, bio-physical, and environment evaluation and comparison of livestock production systems	G, M
- indicators of sustainability - to allow monitoring of changes	G, M

- site-specific information on interactions of ecological and social processes involved in balancing livestock, environment and people	G, M
- Diagnosis of contamination levels	I
- Trade impacts of environmental issues	G,M,I
Information Exchange	
- mechanisms to enhance exchange of information and experiences among all stake holders	G, M, I

"G", "M" and "I" refer to grazing, mixed and industrial systems respectively.

V. IDRC RESEARCH OPPORTUNITIES

Of the many research needs identified by the multi-donor study and the global consultation, some bear particular relevance to IDRC`s current programming and corporate framework. The following research opportunities were derived from the above tables, and from the preceding discussion in view of IDRC`s priorities, expertise and approach to international development. Although they are numbered, they are not in order of priority. Table 3 shows the relation between these research opportunities and IDRC`s programming priorities reflected in the Program Initiatives mentioned in the beginning of this paper.

1. Enhancing the bio-physical and socio-economic roles of livestock in environmental recovery -particularly of soils.

2. Increasing the productivity of mixed systems without sacrificing their social and environmental benefits (as an alternative to intensification and specialization).

3. Understanding human coping mechanisms and adaptation to "non-equilibrium status" of arid ecosystems.

4. Understanding the role of women in the interactions of livestock, environment and human needs; and the differential impact on women of changes in livestock systems and of livestock related environmental degradation.

5. Development of effective resource conflict prevention and resolution mechanisms.

6. Identifying the international and national policies, and the local institutions, that are necessary to allow/ensure meaningful local participation in sustainable resource management, and benefit sharing among and within levels.

7. Understanding of traditional/local animal breeding practices and the relation of these to local culture and socio-economic dynamics. Documentation of traditional/indigenous breeding practices and protection of local gene pools.

8. Developing methods of accurate economic valuation, and socio-economic and bio-

physical monitoring of livestock related environmental degradation, recuperation and conservation that effectively involves stakeholders at all levels including the grassroots.

9. Refining methods of urban livestock keeping to mitigate health hazards for both humans and animals and related conflicts among animal keeping households and local/municipal authorities. Identifying the benefits and the drawbacks of livestock to urban gardens.

10. Addressing the issues emanating from the intensification of livestock production in developing countries.

11. Improving the effectiveness of global electronic multi stakeholder consultations (ICTs) such as the LxE conference

Table 3. Relation of Research Opportunities[6] Identified to IDRC Priorities/Program Initiatives

IDRC PIs / Research Opportunities	PLAW	CBNRM	MINGA	SUB	CFP	EH	ACACIA PAN BELLANET
1. Roles of livestock in environmental recovery	X	X		X			
2. Increase productivity of mixed systems	X	X	X				
3. Human adaptation to "non-equilibrium" of arid ecosystems	X	X		X		X	
4. Role of women in LxE interactions	X	X	X	X	X	X	
5. Resource conflict prevention and resolution	X	X	X				
6. Policies and institutions for local participation	X	X	X				
7. Understanding of traditional breeding practices	X			X			
8. Valuation and monitoring of livestock related environmental degradation	X		X			X	
9. Methods of urban livestock keeping					X	X	

[6] These eleven research opportunities are abbreviated versions from the list in the above text.

IDRC PIs _____ Research Opportunities	PLAW	CBNRM	MINGA	SUB	CFP	EH	ACACIA PAN BELLANET
10. Issues arising from intensification of livestock production in developing countries	X	X	X		X		
11. Improve effectiveness of global electronic multi stakeholder consultations			X				X

VI. CONCLUSIONS

It was established in the multi-donor study and the global consultation that the causal link between livestock and environmental degradation is indirect. That is, that there are many social, cultural, economic, political and institutional variables that are causing livestock production to have detrimental environmental and human consequences. Many of the pressing issues that enter into this debate, including the socio-economic and bio-physical benefits of livestock to their social and natural environments; the effects of outside factors on livestock systems; the need for local participation in natural resource management decision-making; and the need for more effective networking and communication among stakeholders were highlighted. Other issues, such as the role of gender in livestock, environment, human interactions; the need to better understand human adaptation to dynamic arid ecosystems; the equity issues emanating from livestock production in different social and natural environments; and the need to devise methods of analyzing the economic and sociological implications of livestock related environmental degradation were, for the most part, overlooked. From the perspective of IDRC, the issues discussed in the global consultation, and those that received less attention, lend credence to the need for better understanding of the human dimensions of livestock environment interactions.

Numerous research needs, many of which were articulated by the participants of the electronic conference and the local face-to-face roundtables and interviews, emerged from the consultation. This paper has identified, from this list of research needs, and from a consideration of both the issues that were brought up in the consultation and those that were not discussed, ten areas in which IDRC given its priorities, expertise and corporate programming framework, can make a significant difference. These include: looking at the role of women in livestock, environment, human interactions; understanding and enhancing the bio-physical and socio-economic roles of livestock in environmental recovery; increasing the productivity of mixed systems without sacrificing their social and environmental benefits as an alternative to specialization of livestock systems; understanding human adaptation to dynamic arid ecosystems; developing effective resource conflict prevention and resolution mechanisms; understanding traditional breeding practices in relation to their cultural and socio-economic contexts; monitoring livestock related environmental degradation; refining methods of urban livestock keeping; addressing issues

stemming from the intensification of livestock production in developing countries; and improving the effectiveness of electronic multi-stakeholder consultations.

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